National College of Ireland

Higher Diploma in Computing

(HDSDEV_JANBLYR1_O)

Distributed Systems

Terminal-Based Assignment Assessment (TABA) – 2024-25

Saturday 4th May, 09:00 am to Tuesday 7th May, 23:55 pm

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Marks Breakdown: The Terminal Assignment Based Assessments is worth 40% of your overall mark for the module

Duration: The students will have to answer questions (1, 2, 3, 4) and question (a) or (b) from question 5.

All submissions will be electronically screened for evidence of academic misconduct (plagiarism and collusion). The assessment should be submitted via a Turnitin link.

Attachments: None

Presentation of Code: Your code should be presented as follows. You should include screenshots of all the inputs and outputs of your services. You should also include screenshots of all your code in your IDE(whichever IDE you are using ATOM, Eclipse, NetBeans IntelliJ).

1. Consider that you are designing a "Product Management" system that supports at least four operations: you can choose your own product. e.g. "AddProduct", "GetProductDetails", “UpdateProductInventory”, and "ListAllProducts".

Using this scenario, explain and differentiate between the four kinds of service methods supported in gRPC: unary RPC, server streaming RPC, client streaming RPC, and bidirectional streaming RPC.

Include appropriate proto file definitions and sample code in your explanations. For instance, how would each type of method be used in the context of the "Product Management" service? How would these methods be defined in the proto file, and what would the corresponding code look like?

For example, unary RPC might be appropriate for "GetProductDetails" operation, server streaming RPC for "ListAllProducts", client streaming RPC for "AddProduct" operation, and bidirectional streaming RPC for a hypothetical "UpdateProductInventory" operation. Your assignment should include the code (include method declaration/definition, need not include the method logic or full code) and proto file definitions but also thoroughly explain why each service method type is appropriate for each operation in the context of the "Product Management" system.

[25 Marks]

2. Explain the “Product Management” service designed in Q.1 (protos) with the Interface Definition Language (IDL). Then in the context of your implementation, explain with examples.

a. What is the purpose of an Interface Definition Language? **[5 Marks]**

b. Why do we need openness? **[5 Marks]**

3. Discuss mitigation strategies for the following Fallacies of Distributed Computing.

a. The Network is Reliable **[5 Marks]**

b. Latency is zero. **[5 Marks]**

c. Bandwidth is infinite. **[5 Marks]**

4. By using the MQTT protocol implement in Java the Publisher - Subscriber parts of the following application:

Your application simulates a smart office environment, where sensors emit different structural and air properties about the site.

In particular, you have one client (program) that publishes messages every second about the room; like the floor/room/temperature (e.g 17 C) and the floor/room/humidity (e.g. 25%).

You also have another client (program) that publishes messages about the floor every half second like; the floor/light/ID (e.g ON) and the floor/window/location (e.g. OPEN/CLOSE).

a. Implement these 2 publishers and demonstrate the sending of messages on these topics and subtopics. In your solution, for each client you can implement a loop that periodically emits values/readings either randomly or from a list. **[10 marks]**

You should also develop and run different subscribers (hint - copy and change the class name and subscribe method in each case) that listens for messages on the following topics and subtopics

b. strictly messages related to a floor/room/temperature **[5 marks]**
c. any messages that are related to room (including its subtopics) **[5 marks]**
d. messages that are related to the floor for both light and window **[5 marks]**
e. Finally, show and explain how you can facilitate disconnected clients. **[5 marks]**

[30 marks in total]
Must include the screenshot of the code and output.

5. a. Conceptually demonstrate a simple client-server application/scenario with an implementation technology of your choice. Your solution should mention and depict the relations and interactions among the following components: client-part, server-part, middleware and registry. In this scenario, what is the use of middleware and registry?

[20 marks in total]
Explain using any technology of your choice

5.b. Investigate and report how cloud-based systems (select one of Amazon WS, Microsoft Azure, Google Cloud Platform, etc) balance the trade-offs of the PACELC theorem, and what approaches they take to guarantee Consistency, Availability and Partition Tolerance. **[20 Marks]**